

Path Planning Methods for Mobile Robots: A systematic and Bibliometric Review

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Abstract: Robots are currently replacing humans in different tasks in various sectors. Among the vital features desirable in autonomous robots is the capability of navigating safely through a given environment. Robot navigation is a process designed with the ability of avoiding any hitches or obstacles while aiming at a specific predefined position. Many studies have been proposed to find solutions to robot path-planning problems. This paper presents a survey of the heuristic and classical path-planning approaches. Focal strengths, together with the weaknesses of these approaches, were also identified to provide deep insight for future studies. As several literature studies have recommended, classical methods might not be effective in real-time applications as a result of their failure to confront the unpredictable nature of the real-world. They require a considerable amount of computation and space, while heuristic-based methods can overcome real-world problems with some modifications. To summarize the research progress and also suggest future directions of path-planning research, this study performs a bibliometric analysis of the relevant publications published from 2000 to 2020. The results show that 5385 articles were published in 1128 journals, hence indicating publication diversity. There is a steady rise in the yearly publication output, reflecting an increase in global research interest in the topic. In general, this research provides useful insight into path-planning research so that researchers in this area can better recognize the relevant research study topics and search for the appropriate research partners.

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INTRODUCTION

The major emphasis in the field of autonomous control is the need for path planning. There is increased attention in the scientific community to enhance the knowledge of automation systems for different applications, such as chemically polluted or harmful locations [1]. Robotic path planning is an appealing research study in the field of robotics [2]. Since mobile robotics are used in a vast array of applications, numerous researchers have been working on various approaches in order to conquer a few of the significant challenges faced in autonomous navigation. These challenges restrict its usage in many applications, including industrial and military fields [3].

1.1 Path planning

Robot path planning is the process of finding an enhanced collision-free path from a start to a predefined goal point through a certain given cluttered real world environment within the shortest possible time [4], [5]. Siegwart and Nourbakhsh [6] identified path planning as defining a trajectory through a map with which a robotic can reach a known goal point from its starting place while avoiding obstacles.

The four integral path planning components that made up the navigation problem are: Perception, localization, motion control and path planning [7]. Figure 1 below

shows the four integral parts of robot navigation problem. Localization as well as path planning are necessary components in navigating of mobile robots.

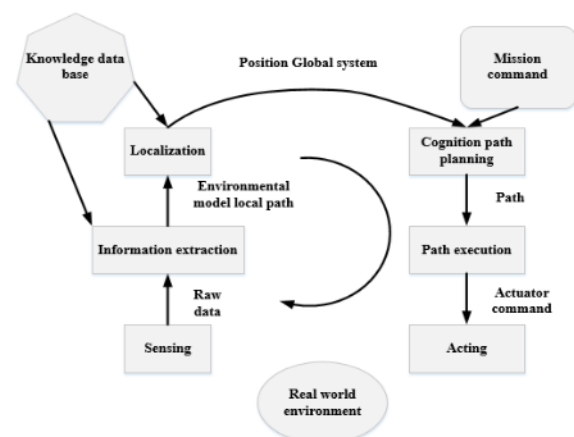


Figure 1: Parts of robot navigation problem [6]

Path planning is a major problem in robotics since its intricacy increases tremendously with the dimension of the configuration area. The configuration area is defined as the space that a physical system might attain relative to the environmental constraints. Choset et al. [8] define it as the space of all arrangements that a robotic can reach.

Path planning algorithms have actually been explained